Donation after Cardiac Death Pediatric En Bloc Renal Transplantation

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Purpose: Use of small pediatric kidneys obtained from extremely young donors after cardiac death has been limited. This potential organ source remains under used by transplant teams.

Materials and Methods: We reviewed all renal transplants at our institution from 2000 to 2013 to identify recipients of an en bloc pair of kidneys from deceased pediatric donors younger than 4 years. The outcomes of donation after cardiac death en bloc allografts were compared with neurological determination of death en bloc allografts.

Results: A total of 21 recipients of en bloc renal allografts were identified, of which 4 organ pairs were obtained through donation after cardiac death. Mean ± SD donor age was 20.6 ± 11.6 months and weight was 12.4 ± 3.7 kg. Delayed allograft function occurred in 2 of 4 recipients of allografts obtained from donation after cardiac death en bloc and 3 of 17 recipients of allografts from neurological determination of death en bloc. One year after transplantation mean ± SD glomerular filtration rates were similar, at 80.7 ± 15.3 and 85.7 ± 33.4 ml/minute/1.73 m^2 in the cardiac and neurological allograft groups, respectively (difference not significant). Surgical complications occurred in 3 patients, and no allograft was lost to thrombosis.

Conclusions: We report successful transplantation of a small cohort of pediatric en bloc kidneys obtained through donation after cardiac death from donors younger than 4 years. Outcomes at 1 year are comparable to those in neurological determination of death en bloc allograft recipients.

Key Words: donor selection, kidney transplantation, tissue and organ procurement

Abbreviations and Acronyms

DCD = donation after cardiac death

DGF = delayed graft function

GFR = glomerular filtration rate

NDD = neurological determination of death

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RENAL allografts from young donors are under used by organ transplantation teams.[1,2] This situation likely stems from concerns over early graft loss, since venous thrombosis of pediatric kidneys is reported to be approximately 10%.[3–6] However, detailed analysis of the Scientific Registry of Transplant Recipients shows that the risk of graft loss is mitigated when renal allografts are transplanted en bloc rather than as single units when procured from donors weighing less than 21 kg.[2]

En bloc renal allografts are kidney pairs with intact vasculature that are procured from donors and transplanted as a single unit. Initial studies of pediatric en bloc kidneys have revealed good long-term function compared to single deceased donor adult allografts.[3–7] More recent

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studies have demonstrated that recipients of pediatric en bloc renal allografts have comparable graft survival to living donor recipients.[8,9]

During the last decade the use of DCD renal allografts in North America has increased. Several studies support that, despite a higher rate of DGF, long-term allograft survival outcomes are similar to those following NDD transplant.[10,11] DCD now constitutes up to 33% of donations in the United Kingdom,[11] as well as 12% of all deceased donations in the United States.[12]

Interest in DCD in the pediatric population has increased significantly, driven by the ongoing disparity between supply of and demand for transplantable organs, and increased interest and knowledge among caregivers and families of children who are potential donors.[13] A study of 105 American pediatric hospitals showed that 72% have policies on DCD and 19% have policies in development.[14]

Although approximately 5.5% of children dying in a pediatric intensive care unit were deemed eligible for DCD donation in 1 series,[15] few documented cases of pediatric DCD transplantation exist, and the functional outcomes of these grafts have not been studied. We review our experience with pediatric en bloc renal transplantation. We compare the baseline characteristics and functional outcomes of NDD and DCD en bloc allografts, and describe our surgical methods and complications.

MATERIALS AND METHODS

Study Methods

Institutional review board approval was obtained for our study. We reviewed all renal transplants at our center and identified 21 recipients of en bloc kidney pairs from pediatric donors 4 years or younger between July 2001 and January 2013. We examined donor and recipient characteristics, perioperative characteristics, surgical complications, allograft outcomes and recipient graft function. The primary goal was to examine allograft outcomes and report recipient renal function in NDD and DCD subgroups. We also evaluated the frequency and nature of perioperative complications.

Transplant Methods

A total of 18 allografts were maintained with static cold storage and 3 with hypothermic pulsatile machine perfusion. Organs were flushed and preserved with University of Wisconsin solution. Organ allocation was modified to avoid recipients known to have severe atherosclerosis in an attempt to limit technical challenges to the vascular anastomoses. Highly sensitized recipients were also excluded to minimize the risk of acute rejection, which could necessitate postoperative biopsy of these small en bloc allografts. Accordingly all patients received antithymocyte globulin as induction therapy to minimize the risk of acute rejection and to curb the adaptive immune response to the warm ischemic damage sustained by DCD retrieval. Maintenance immunotherapy included tacrolimus, mycophenolate mofetil and prednisone. Allograft Doppler ultrasounds were performed on post-transplant day 1 and as needed thereafter.

Surgical Methods

During organ retrieval both kidneys and their vasculature, including proximal and distal portions of the aorta and vena cava, were removed en bloc. During preparation of the specimen the proximal inferior vena cava and aorta were oversewn and the distal ends were left open for anastomosis to the recipient iliac vessels. Lumbar, adrenal and gonadal vessels were clipped as required. In some cases more extensive vascular reconstruction was required at the discretion of the supervising surgeon. The distal vena cava and aorta were anastomosed to recipient external iliac vessels. The 2 ureters were spatulated and anastomosed via the Wallace technique and then implanted into the recipient bladder using an extravesical approach. Both ureters were stented and the stents were removed 4 weeks after transplantation. Postoperatively recipients underwent heparin infusion for thrombosis prevention. No preoperative anticoagulation was administered. The protocol for heparin infusion varied based on surgeon preference.

Data Analysis

Glomerular filtration rate in adult recipients was calculated using the 4-variable MDRD (Modification of Diet in Renal Disease Study) equation.[16] In pediatric donors GFR was calculated using the Schwartz formula.[17] DGF was defined as the requirement for dialysis in the first week after transplantation. Length of followup was determined by the interval between transplantation and the most recent available creatinine value. Where completed, 2-sided p values were calculated using Student t-tests for continuous variables and Fisher exact tests for categorical outcomes. Statistical significance was designated as a 2-sided p value of less than 0.05.

RESULTS

A total of 21 recipients of en bloc allografts were identified, of whom 4 received DCD allografts. Donor, recipient and transplantation characteristics are outlined in the supplementary table (http://jurology.com/). Demographics were similar between the groups. Average donor age was younger than 2 years (mean $\pm$ SD 20.6 $\pm$ 11.6 months), with 7 donors being younger than 1 year. Correspondingly mean $\pm$ SD donor weight was 12.4 $\pm$ 3.7 kg, with 5 donors weighing less than 10 kg. Delayed graft function was observed in 2 of 4 DCD and 3 of 17 NDD recipients. Recipient GFR as a function of time following transplantation is outlined in the figure. In the first week following transplantation GFR was less in the DCD cohort. This was an anticipated finding, given the higher rates of delayed graft function associated with DCD